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UPPER-LEVEL PRECESSION PHOTOGRAPHY AND THE LORENTZ-POLARIZATION CORRECTION

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H. J. Grenville-Wells and S. C. Abrahams

Laboratory for Insulation Research

Massachusetts Institute of Technology

Cambridge, Massachusetts

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Abstract: A set of charts for 7 levels in reciprocal space, 0.05 rlu apart, which enable the Lorentz-polarization correction for any reflection to be read easily, is presented. These charts are in a form directly comparable with the Waser zero-level correction chart.

In order to convert photographic measurements of the intensity of X-ray diffraction spectra into the series of relative values which are a consequence of the arrangement of the atoms in a crystal, allowance must be made for certain geometrical factors that are dependent on the angle between the direct beam and the diffraction spectrum in question. These factors vary from one experimental technique to another; in each case they are usually considered together as one expression known as the Lorenz-polarization correction.

Since experimental intensity measurements are usually assumed to be liable to errors up to 10 percent, sufficient accuracy is obtained by applying the Lorenz-polarization correction graphically: a chart is constructed on which the X-ray film can be superposed and the correction read off at the positions at which diffraction spectra occur.

Such a chart has been published by Waser[1] for zero-level photographs taken with the Buerger precession camera, and recently Burbank[2] made the necessary calculations for applying corrections to upper-level precession

1) J. Waser, Rev. Sci. Instr. 22, 567 (1951).

2) R. D. Burbank, Rev. Sci. Instr. 23, 321 (1952).

photographs. Burbank's charts are not, however, of the type in which the correction can be obtained merely by superposing a film on the appropriate chart. Therefore, charts have been redrawn of the Lorentz-polarization correction for upper-level precession photographs obtained with a precession angle $\bar{\mu} = 30^{\circ}$. Seven charts, comparable with Waser's Lorentz-polarization correction chart for the zero level, are given at intervals of 0.05 rlu above the zero level, corresponding to a magnification factor F = 5.5 cm.

The Lorentz polarization correction for precession photographs with the precession angle $\bar{\mu} = 30^{\circ}$ has been evaluated by Burbank[2] at about 1300 points in reciprocal space. The most convenient way of expressing this function is probably in the form of charts comparable with Waser's chart[1] for the Lorentz polarization correction of the zero level in precession photographs. A set of charts, Figs. 1–7, derived from large scale drawings of Figs. 1–7,[2] are now offered, drawn at intervals of 0.05 rlu above the zero level. The errors in these diagrams are comparable with the error of about 0.35 percent in the evaluated function.

Figures 1–7 may be used directly with upper-level precession photographs having a magnification factor[3] F = 5.5 cm. Corrections for reciprocal levels at intermediate heights may be made by linear interpolation, this operation becoming very rapid if the charts are reproduced on transparent film, and if the reciprocal lattice is drawn out, instead of using the film directly. In these charts, the horizontal direction is parallel with the oscillation axis of the crystal, $\tau = 0^{\circ}$.

Acknowledgment

We wish to thank Dr. R. D. Burbank for making his charts available to us prior to publication, and Mr. J. J. Maccarrone for the excellence of the finished charts.

3) M. J. Buerger, "The photograph of the reciprocal lattice," Am. Soc. X-ray and Electron Diffraction Monograph No. 1 (1944).

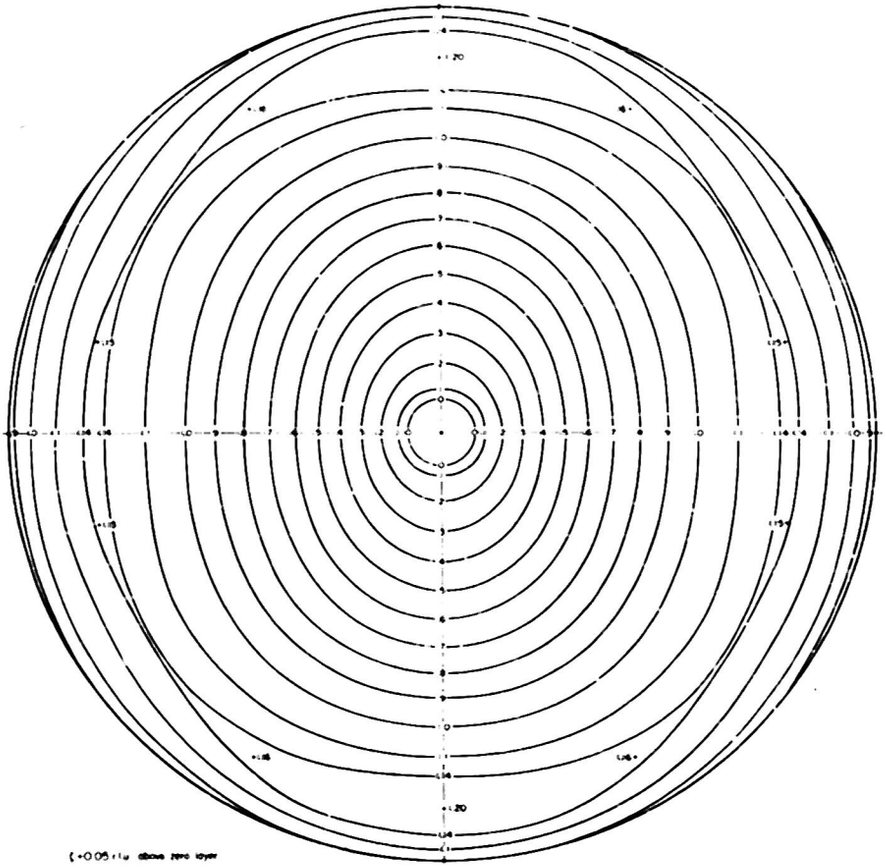

Fig. 1. Lorentz polarization correction chart at ζ = 0.05 rlu above the zero level, $\bar{\mu} = 30^{\circ}$.

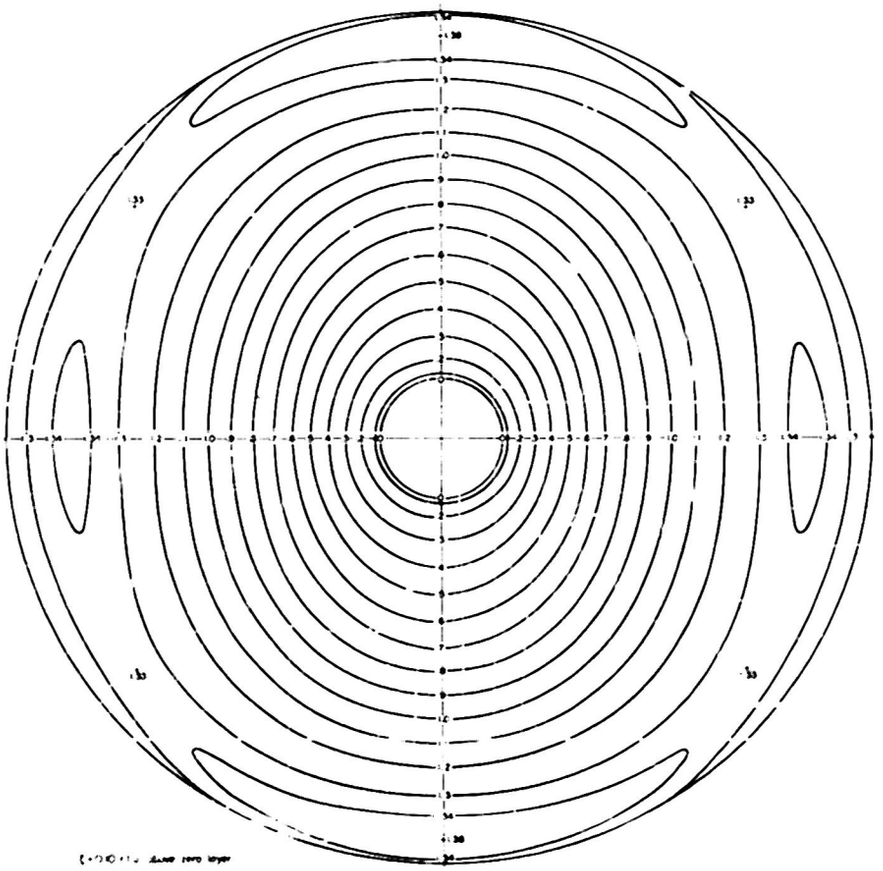

Fig. 2. Lorentz polarization correction chart at ζ = 0.10 rlu above the zero level, $\bar{\mu} = 30^{\circ}$.

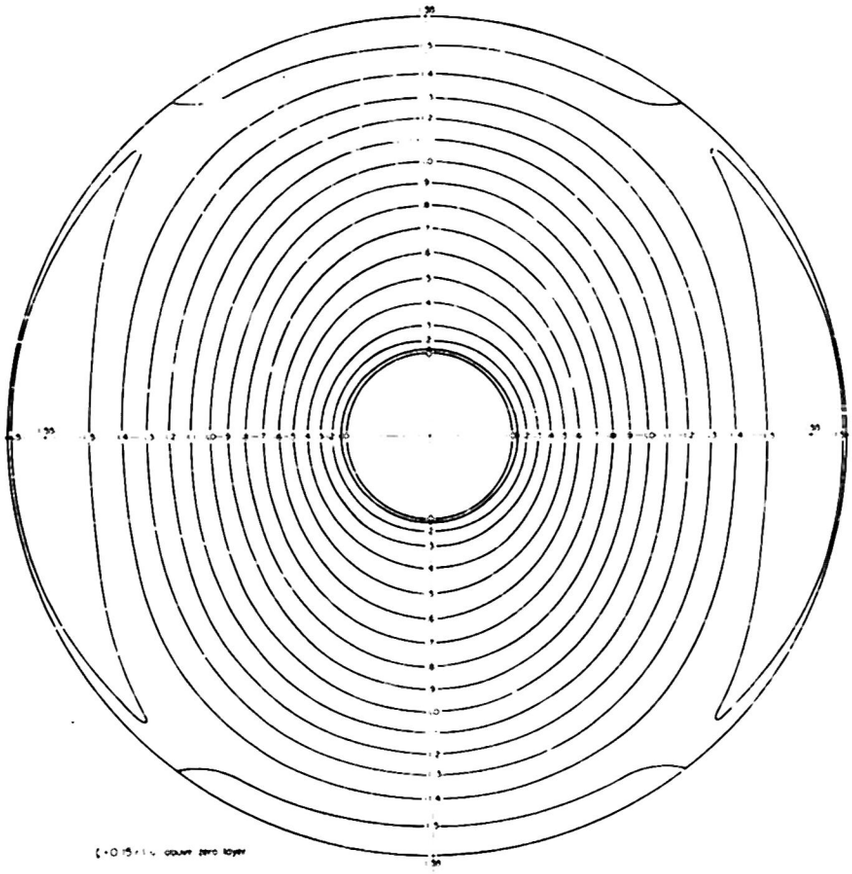

Fig. 3. Lorentz polarization correction chart at ζ = 0.15 rlu above the zero level, $\bar{\mu} = 30^{o}$.

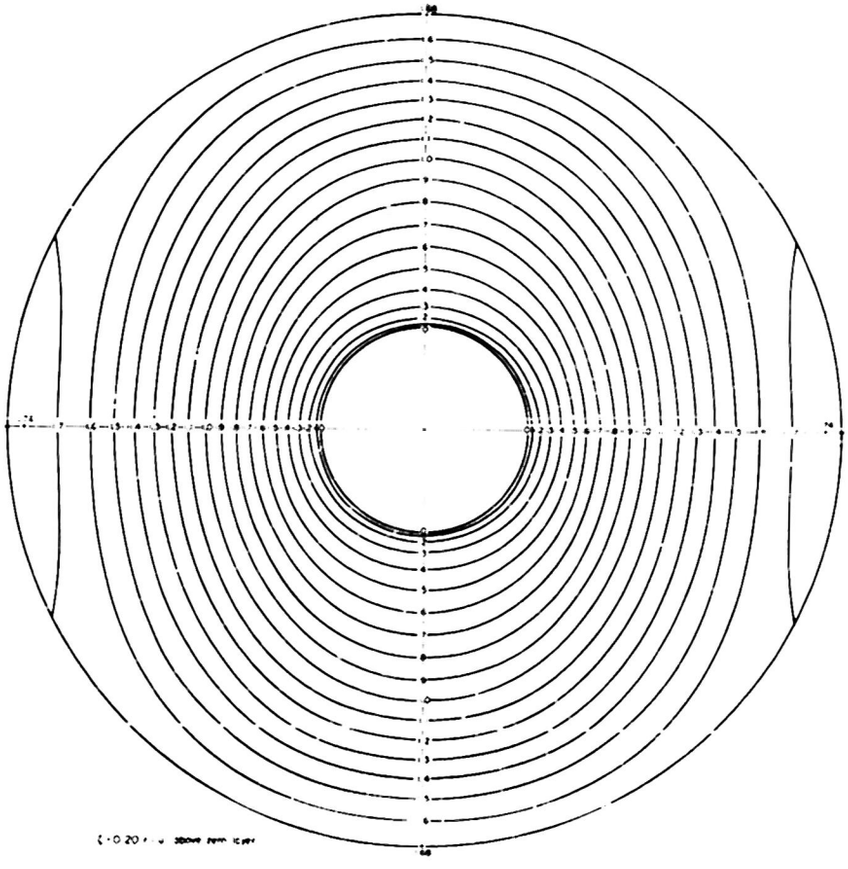

Fig. 4. Lorentz polarization correction chart at ζ = 0.20 rlu above the zero level, $\bar{\mu} = 30^{o}$.

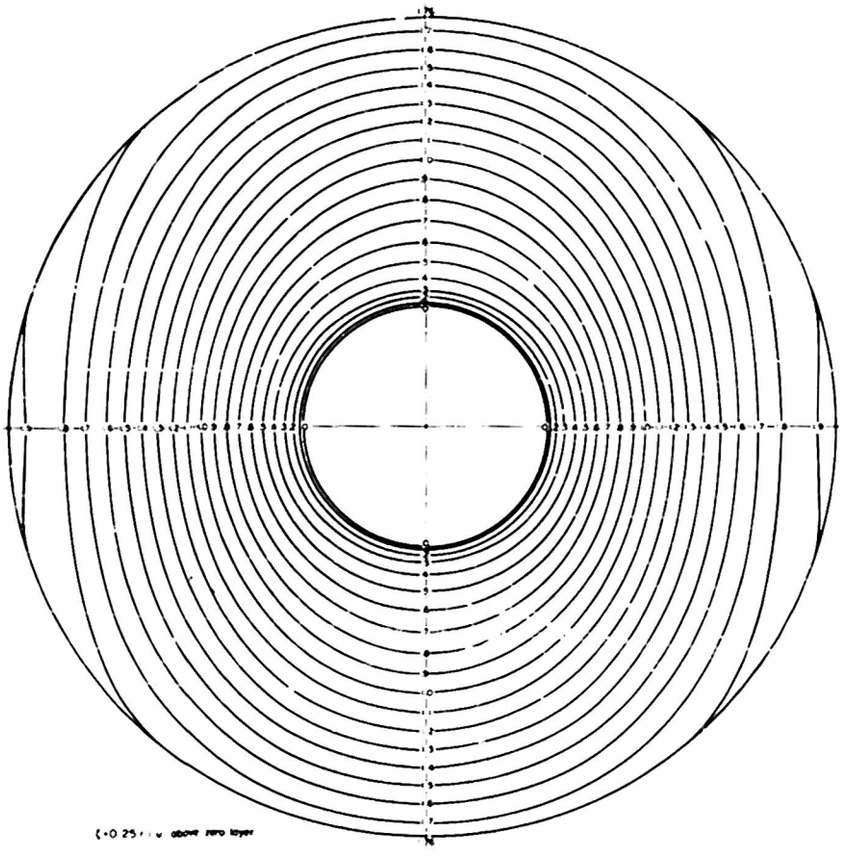

Fig. 5. Lorentz polarization correction chart at ζ = 0.25 rlu above the zero level, $\bar{\mu} = 30^{o}$.

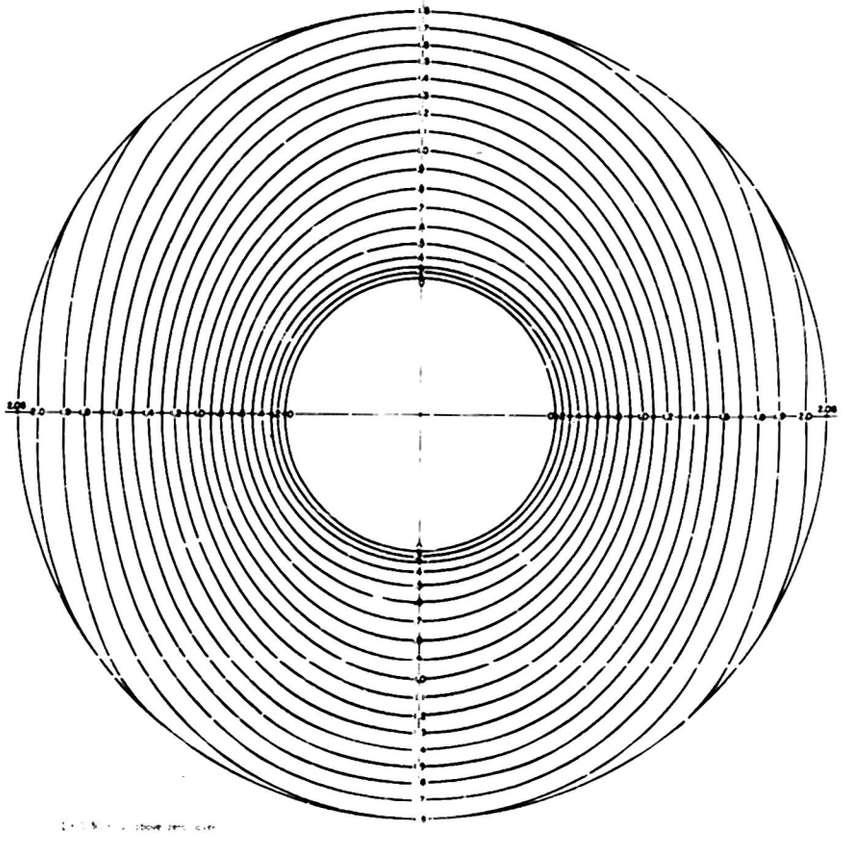

Fig. 6. Lorentz polarization correction chart at ζ = 0.30 rlu above the zero level, $\bar{\mu} = 30^{o}$.

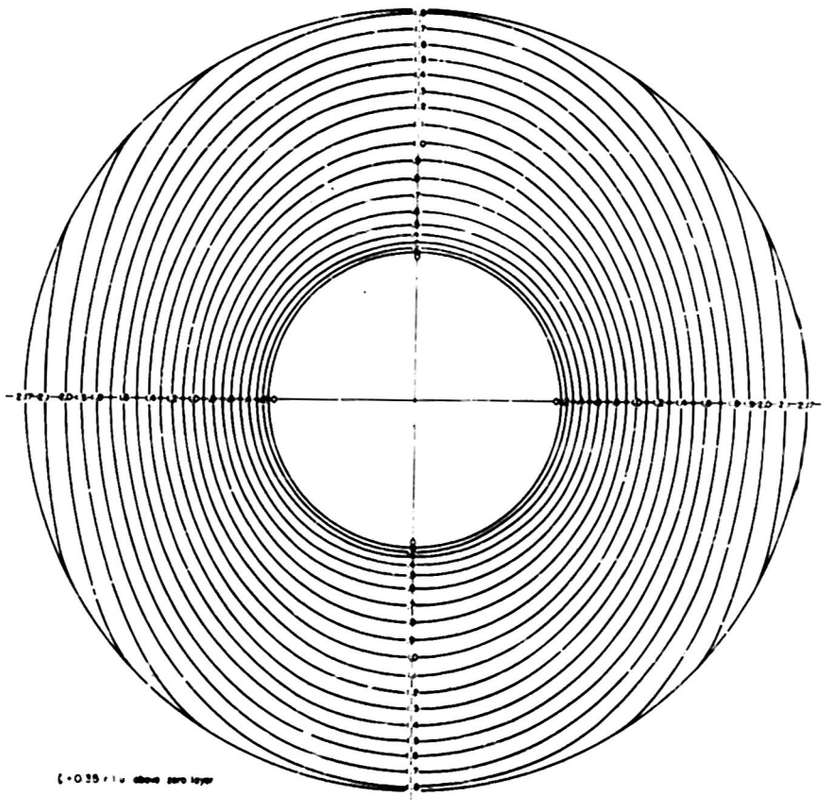

Fig. 7. Lorentz polarization correction chart at ζ = 0.35 rlu above the zero level, $\bar{\mu} = 30^{o}$.